

## Unit 4 – Describing Substance - Objectives

1. Distinguish (at both macroscopic and microscopic levels) between a pure substance and a mixture.	
2. Describe (at both macroscopic and microscopic levels) the law of definite composition.	
3. Describe the evidence that supports the idea that the simple particles have a property we call charge	
4. Describe a model of the atom that accounts for the fact that neutral particles can become either positively or negatively charged	

5. Describe the evidence that distinguishes ionic from molecular or atomic solids.	
6. Given the formula of an ionic or molecular substance, state its name.	
7. Given the name of ionic or molecular substance, write its formula.	
8. From the name or formula of a substance determine whether that substance is ionic or molecular.	

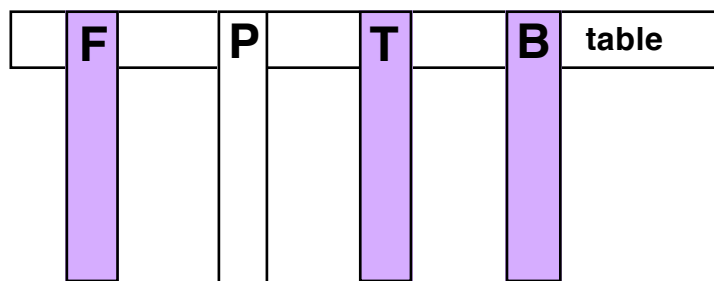
# Chemistry - Unit 4 Sticky Tape Activity

## Part 1 – Preparing the tapes - examining their behavior

1. Take a 15 cm piece of transparent tape and make a handle on the end by folding under the first cm of tape, sticky side to sticky side. Place this tape on the lab table. This is the base tape.
2. Take a second 15 cm piece of transparent tape, make a handle as before, and place this tape on top of the base tape. Label this tape “B” for bottom.
3. Attach a third similarly prepared strip of tape onto the bottom tape. Label this tape “T” for top.



4. Repeat steps 1 through 3 above. You now have two sets of 3-layer tapes.
5. Obtain 2 pieces of paper, the same dimensions as the tapes, and hang one from the edge of the table. Label the hanging paper “P.” Approach the hanging paper with the other piece of paper. *Describe what you see.*
6. Obtain 2 pieces of aluminum foil, the same dimensions as the tapes, and hang one from the edge of the table. Label the hanging foil “F.” Approach the hanging foil with the other piece of foil. *Describe what you see.*
7. Peel one set of T and B tapes from its base tape, keeping the T and B tapes together. Run your finger down the non-sticky side, then quickly peel them apart.
8. Hang each strip next to the hanging paper and foil.



9. Repeat step 7 with the other set of tapes.
10. With a T tape hanging from one hand and a B tape hanging from the other, experiment by approaching each of the hanging tapes, the foil strip and the strip of paper. *Be sure to describe the kind of interaction you see as you bring each of the tapes near the hanging tapes and strips.*

	Top	Bottom	Foil	Paper
Top				
Bottom				
Foil				
Paper				
Plastic				
(Other)				

## Part 2 - The assignment of (+) and (-) charges

After you have summarized your findings (attraction, repulsion or no interaction) for the two tapes, foil and paper, rub a hard rubber or plastic rod with fur or wool. Approach the T tape, the B tape, the foil and the paper with the rod. *Describe what you see. Does the rod behave more like the T tape or the B tape?*

Based on a number of observations scientists have assigned the label of negative (–) to the charge of a rubber or plastic rod rubbed with fur or wool. The fur or wool becomes positively charged (+). Based on your observations from using the rod, label the T and B tapes as either a (+) or (–).

Now, reflect on the relative strengths of the interactions between the tapes, foil and paper. How did attraction between the T or B tape and the foil or paper compare to the interaction between tapes? You may need to repeat step 10 to answer this question.

## Unit 4 – Worksheet 1

### Molecular Compounds

Properties

Basic structural unit

Laws of definite & multiple proportions

1. Name each of the following binary compounds of non-metallic elements

a.  $\text{CBr}_4$

b.  $\text{N}_2\text{P}_3$

c.  $\text{PCl}_3$

d.  $\text{ICl}$

e.  $\text{N}_2\text{O}$

f.  $\text{SiF}_4$

2. Write the name for the following compounds of nonmetallic elements.

a.  $\text{GeH}_4$

b.  $\text{N}_2\text{Br}_4$

c.  $\text{P}_2\text{S}_5$

d.  $\text{SeO}_2$

e.  $\text{NH}_3$

f.  $\text{SiO}_2$

3. Write the formula for the following binary compounds of nonmetallic elements.

a. phosphorus triiodide

b. silicon tetrachloride

c. dinitrogen pentoxide

e. dinitrogen tetroxide

f. carbon monoxide

4. Write the formula for these compounds of nonmetallic elements.

a. carbon dioxide

b. sulfur hexafluoride

c. dinitrogen tetrachloride

d. carbon tetraiodide

e. phosphorus pentafluoride

f. diphosphorus pentoxide

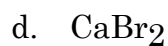
## Unit 4 – Worksheet 2

### Ionic Compounds

Properties

Basic structural unit

1. Give the name of the following simple binary ionic compounds.



2. Give the name of the following simple binary ionic compounds.



3. Write the formula for the following binary ionic compounds.

a. lithium bromide

- b. sodium iodide
  - c. silver sulfide
  - d. cesium oxide
  - d. beryllium iodide
  - f. barium hydride
  - g. aluminum fluoride
  - h. potassium oxide
4. Write the formula for these ionic substances.
- a. silver oxide
  - b. aluminum sulfide
  - c. sodium nitride
  - d. barium chloride
  - e. strontium hydride

5. Write the name of these ionic substances using a Roman numeral to specify the charge of the cation.

a.  $\text{SnBr}_2$

b.  $\text{SnBr}_4$

c.  $\text{CrO}$

d.  $\text{Cr}_2\text{O}_3$

e.  $\text{Hg}_2\text{I}_2$

f.  $\text{HgI}_2$

6. Write the name of these ionic substances using a Roman numeral to specify the charge of the cation.

a.  $\text{PbCl}_2$

b.  $\text{Fe}_2\text{O}_3$

c.  $\text{SnI}_2$

d.  $\text{Hg}_2\text{O}$

e.  $\text{HgS}$

f.  $\text{CuI}$

7. Write the formulas of each ionic compound.

a. chromium (III) chloride

b. tin (IV) oxide

c. lead (II) oxide

d. copper (II) iodide

e. cobalt (II) oxide

f. cobalt (III) oxide

8. Write the formulas of each ionic compound.

a. chromium (III) sulfide

b. manganese (IV) oxide

c. gold (III) chloride

d. titanium (IV) chloride

e. iron (II) bromide


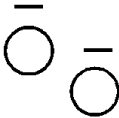


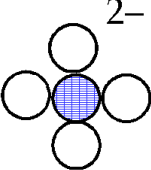
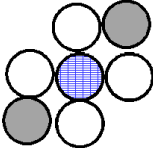
f. iron (II) oxide

POSITIVE IONS (CATIONS)		NEGATIVE IONS (ANIONS)	
<b>GROUP 1 Elements</b> 1+		<b>GROUP 16 Elements</b> 2-	
examples:		the names end in "ide"	
lithium		examples:	
sodium	Li <sup>+</sup>	oxide	O <sup>2-</sup>
potassium	Na <sup>+</sup>	sulfide	S <sup>2-</sup>
<b>GROUP 2 Elements</b> 2+		<b>GROUP 17 Elements</b> 1-	
examples:		the names end in "ide"	
beryllium		examples:	
magnesium	Be <sup>2+</sup>	fluoride	F <sup>-</sup>
calcium	Mg <sup>2+</sup>	chloride	Cl <sup>-</sup>
<b>POLYATOMIC CATION</b>		<b>POLYATOMIC ANIONS</b>	
ammonium	NH <sub>4</sub> <sup>+</sup>	acetate	C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> <sup>-</sup>
<b>TRANSITION ELEMENTS</b>		carbonate	CO <sub>3</sub> <sup>2-</sup>
require Roman numerals		hydrogen carbonate	HCO <sub>3</sub> <sup>-</sup>
copper(I)	Cu <sup>+</sup>	(bicarbonate)	
copper(II)	Cu <sup>2+</sup>		
iron(II)	Fe <sup>2+</sup>	chlorate	ClO <sub>3</sub> <sup>-</sup>
iron(III)	Fe <sup>3+</sup>	chromate	CrO <sub>4</sub> <sup>2-</sup>
lead(II)	Pb <sup>2+</sup>	hydroxide	OH <sup>-</sup>
lead(IV)	Pb <sup>4+</sup>	nitrate	NO <sub>3</sub> <sup>-</sup>
mercury(I)	Hg <sub>2</sub> <sup>2+</sup>	nitrite	NO <sub>2</sub> <sup>-</sup>
mercury(II)	Hg <sup>2+</sup>	oxalate	C <sub>2</sub> O <sub>4</sub> <sup>2-</sup>
nickel(II)	Ni <sup>2+</sup>	permanganate	MnO <sub>4</sub> <sup>-</sup>
tin(II)	Sn <sup>2+</sup>	phosphate	PO <sub>4</sub> <sup>3-</sup>
tin(IV)	Sn <sup>4+</sup>		
(not requiring Roman numerals)		sulfate	SO <sub>4</sub> <sup>2-</sup>
zinc	Zn <sup>2+</sup>	sulfite	SO <sub>3</sub> <sup>2-</sup>
cadmium	Cd <sup>2+</sup>		
silver	Ag <sup>+</sup>	hydride	H <sup>-</sup>
<b>MISC</b>			
aluminum	Al <sup>3+</sup>		
hydrogen	H <sup>+</sup>		

Name \_\_\_\_\_

# Unit 4 Worksheet 3

## Representing Ions and Empirical Formulas

	IONS	FORMULA	NAME
1.	$\text{Ca}^{2+}$ and $\text{Br}^{-}$  		
2.	$\text{Fe}^{2+}$ and $\text{Cl}^{-}$		
3.	$\text{K}^{+}$ and $\text{SO}_4^{2-}$  		
4.	$\text{Al}^{3+}$ and $\text{NO}_3^{-}$		
5.	$\text{Pb}^{2+}$ and $\text{S}^{2-}$		
6.	_____ and _____	$\text{NH}_4\text{OH}$	
7.	_____ and _____	$\text{KHCO}_3$	

8. \_\_\_\_\_ and \_\_\_\_\_  $\text{Mg}(\text{NO}_2)_2$  \_\_\_\_\_
9. \_\_\_\_\_ and \_\_\_\_\_  $\text{ZnCO}_3$  \_\_\_\_\_
10. \_\_\_\_\_ and \_\_\_\_\_  $\text{Na}_3\text{PO}_4$  \_\_\_\_\_
- For 11 – 15 state the total number of atoms and the number of ions in the compound
11. \_\_\_\_\_ and \_\_\_\_\_ \_\_\_\_\_ silver chromate  
\_\_\_\_\_atoms \_\_\_\_\_ ions
12. \_\_\_\_\_ and \_\_\_\_\_ \_\_\_\_\_ lithium chlorate  
\_\_\_\_\_atoms \_\_\_\_\_ ions
13. \_\_\_\_\_ and \_\_\_\_\_ \_\_\_\_\_ copper (II) nitrate  
\_\_\_\_\_atoms \_\_\_\_\_ ions
14. \_\_\_\_\_ and \_\_\_\_\_ \_\_\_\_\_ iron (III) sulfide  
\_\_\_\_\_atoms \_\_\_\_\_ ions
15. \_\_\_\_\_ and \_\_\_\_\_ \_\_\_\_\_ calcium sulfate  
\_\_\_\_\_atoms \_\_\_\_\_ ions

Name \_\_\_\_\_

## Unit 4 – Activity: Precipitates

Combine two drops of each reactant ( left of the arrow,  $\longrightarrow$ ) on the glass plate.

The products are right of the arrow.

(ppt) means precipitate, flecks of solid formed.

(aq) means aqueous, or in solution, no solid formed.

(s) means solid, (l) means liquid, (g) means gas

Write the chemical formula for each compound in the reaction.

Under the chemical formula for the precipitate (ppt), write the **color** of the precipitate.

1. Nickel(II) chloride(aq) + sodium sulfide(aq)  $\longrightarrow$  nickel(II) sulfide (ppt) + sodium chloride (aq)
2. Barium nitrate (aq) + copper(II) sulfate  $\longrightarrow$  barium sulfate (ppt) + copper(II) nitrate (aq)
3. Sodium carbonate(aq) + calcium chloride(aq)  $\longrightarrow$  calcium carbonate (ppt) + sodium chloride (aq)
4. Potassium chromate (aq) + silver nitrate (aq)  $\longrightarrow$  silver chromate (ppt) + potassium nitrate (aq)
5. Silver nitrate (aq) + nickel(II) chloride (aq)  $\longrightarrow$  silver chloride (ppt) + nickel nitrate (aq)
6. Cobalt(II) nitrate and sodium hydroxide (aq)  $\longrightarrow$  cobalt(II) hydroxide (ppt) + sodium nitrate (aq)
7. Potassium iodide (aq) and lead(II) nitrate (aq)  $\longrightarrow$  lead(II) iodide (ppt) + potassium nitrate (aq)

Name \_\_\_\_\_

Date \_\_\_\_\_ Pd \_\_\_\_\_

## Chemistry: Unit 4 - Worksheet 4

### More Empirical Formulas

IONS			FORMULA	NAME
1. $\text{Na}^+$	and	$\text{Br}^-$	_____	_____
2. $\text{Cu}^+$	and	$\text{SO}_4^{2-}$	_____	_____
3. $\text{Pb}^{2+}$	and	$\text{Cl}^-$	_____	_____
4. $\text{K}^+$	and	$\text{S}^{2-}$	_____	_____
5. $\text{Sn}^{2+}$	and	$\text{F}^-$	_____	_____
6. _____	and	_____	$\text{BaI}_2$	_____
7. _____	and	_____	$\text{AlCl}_3$	_____
8. _____	and	_____	$\text{Mg}(\text{NO}_3)_2$	_____
9. _____	and	_____	$\text{KOH}$	_____
10. _____	and	_____	$(\text{NH}_4)_2\text{SO}_4$	_____
11. _____	and	_____	_____	silver oxide
12. _____	and	_____	_____	lithium bromide
13. _____	and	_____	_____	copper (II) nitrate
14. _____	and	_____	_____	magnesium chloride
15. _____	and	_____	_____	calcium carbonate
16. $\text{Mg}^{2+}$	and	$\text{NO}_3^-$	_____	_____
17. $\text{Cu}^{2+}$	and	$\text{OH}^-$	_____	_____
18. _____	and	_____	$\text{NaHCO}_3$	_____
19. _____	and	_____	_____	iron (III) sulfide
20. _____	and	_____	_____	potassium chromate

**Part II**

Write the names of the following compounds

1.  $\text{Cu}(\text{NO}_3)_2$  \_\_\_\_\_
2.  $\text{BaCl}_2$  \_\_\_\_\_
3.  $\text{HgO}$  \_\_\_\_\_
4.  $\text{Ni}(\text{OH})_2$  \_\_\_\_\_
5.  $\text{Na}_3\text{PO}_4$  \_\_\_\_\_
6.  $\text{CaCO}_3$  \_\_\_\_\_
7.  $\text{CS}_2$  \_\_\_\_\_
8.  $\text{SnBr}_4$  \_\_\_\_\_
9.  $(\text{NH}_4)_2\text{CrO}_4$  \_\_\_\_\_
10.  $\text{Mg}(\text{NO}_3)_2$  \_\_\_\_\_
11.  $\text{Li}_2\text{O}$  \_\_\_\_\_
12.  $\text{FeS}$  \_\_\_\_\_
13.  $\text{NI}_3$  \_\_\_\_\_
14.  $\text{H}_2\text{SO}_4$  \_\_\_\_\_
15.  $\text{K}_2\text{C}_2\text{O}_4$  \_\_\_\_\_

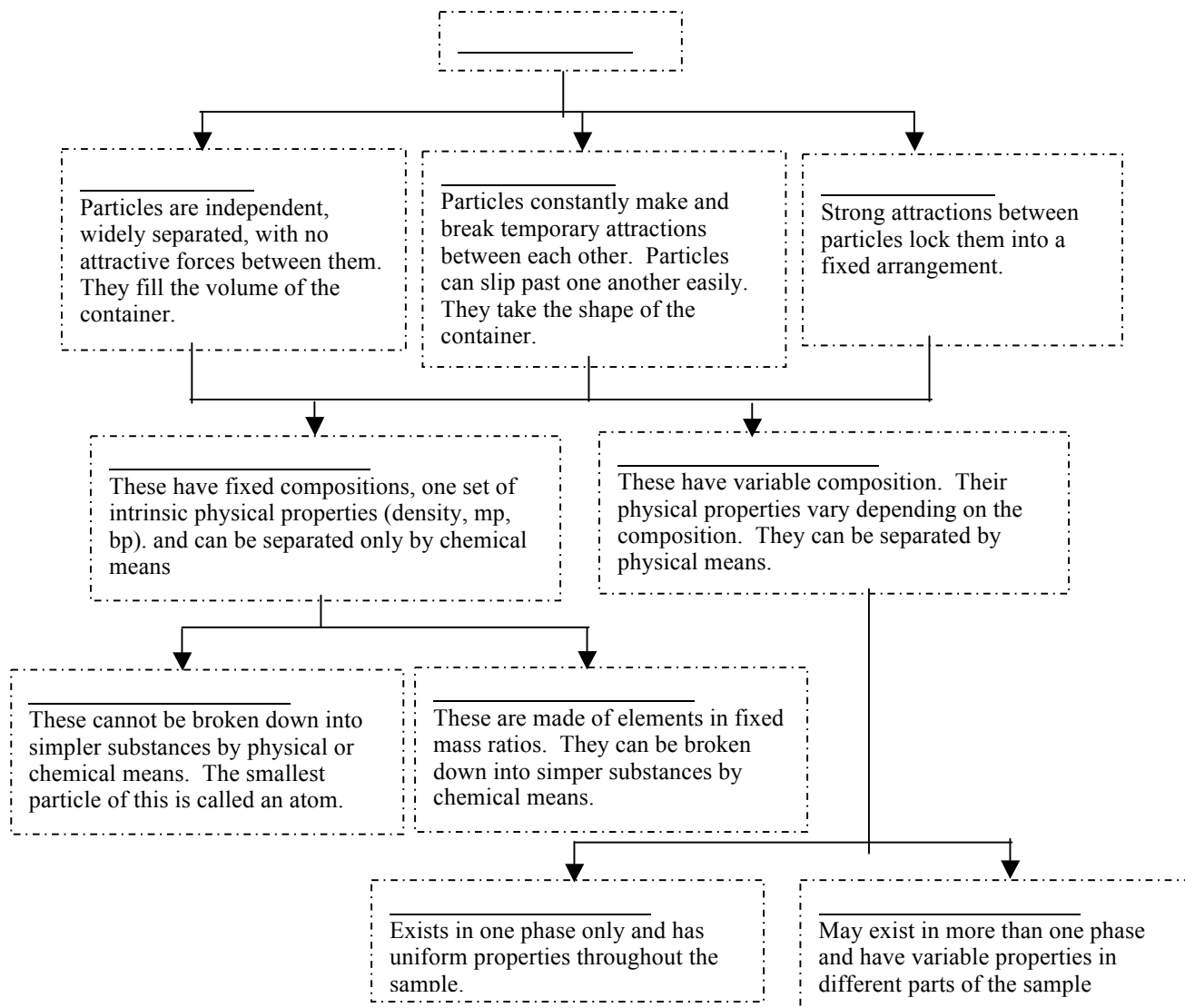
### Part III

Write the formulas for the following compounds

- |                                |  |
|--------------------------------|--|
| 1. copper (II) sulfate _____   | 2. sodium chromate _____               |
| 3. iron (III) chloride _____   | 4. silver sulfide _____                |
| 5. aluminum oxide _____        | 6. zinc nitrate _____                  |
| 7. potassium phosphate _____   | 8. strontium fluoride _____            |
| 9. ammonium carbonate _____    | 10. magnesium hydroxide _____          |
| 11. carbon tetrachloride _____ | 12. phosphorus tribromide _____        |
| 13. sulfur hexafluoride _____  | 14. sulfur dioxide _____               |
| 15. chromium (III) oxide _____ | 16. nitric acid _____                  |
| 17. hydrochloric acid _____    | 18. lead(II) iodide _____              |
| 19. ammonium nitrite _____     | 20. potassium hydrogen carbonate _____ |

# Unit 4 – Review

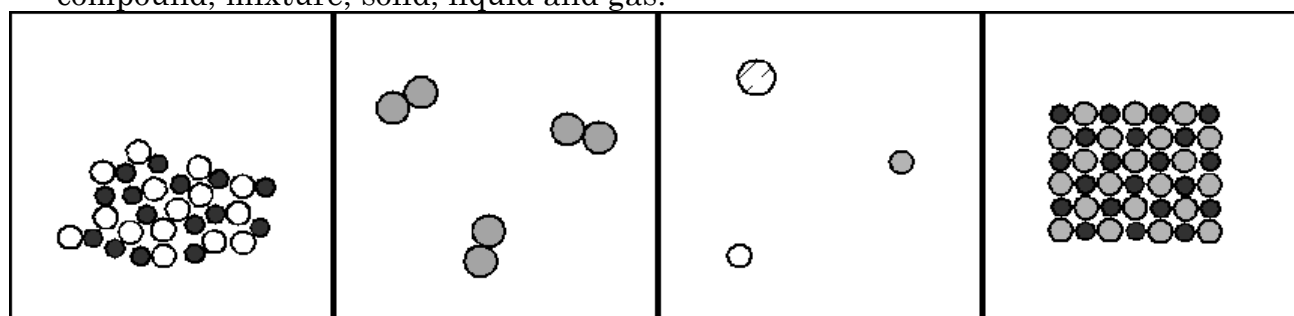
Fill in the blanks in the table with the words in the list below.



Heterogeneous  
 Matter  
 Pure Substance  
 Elements  
 Homogeneous

Liquid  
 Solid  
 Mixtures  
 Compounds  
 Gases

1. Describe the contents of each cell using the terms atoms, molecules, element, compound, mixture, solid, liquid and gas.



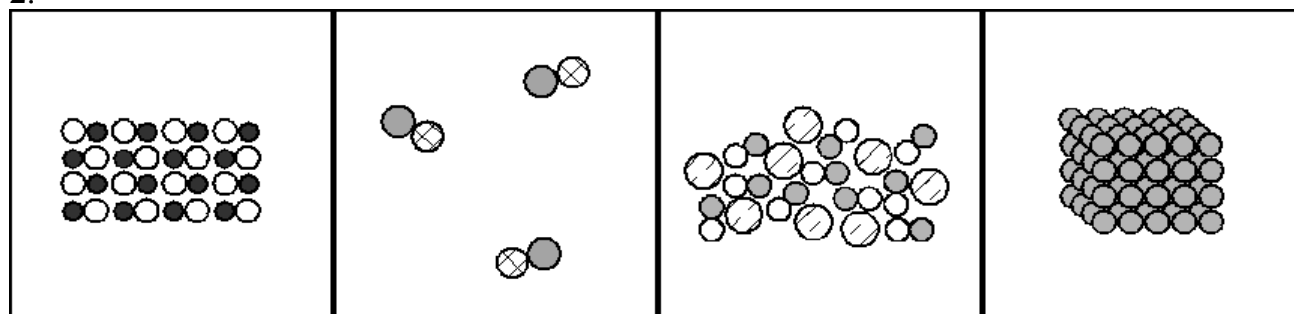
A

B

C

D

2.



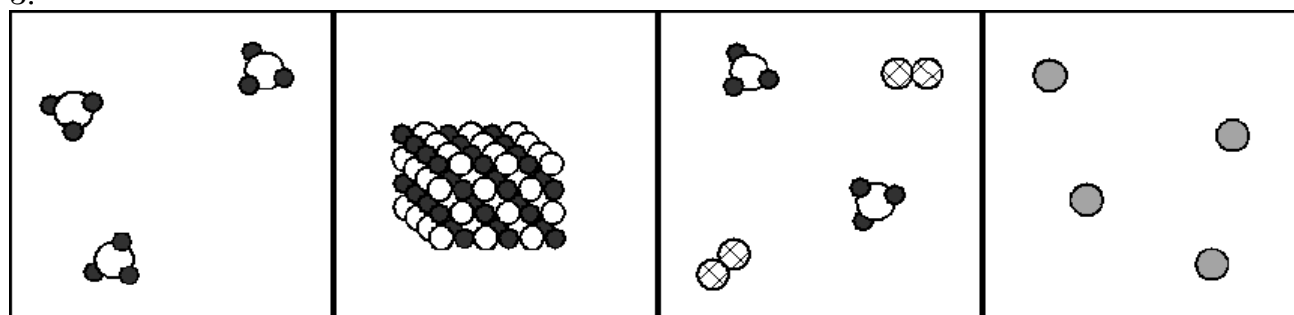
A

B

C

D

3.



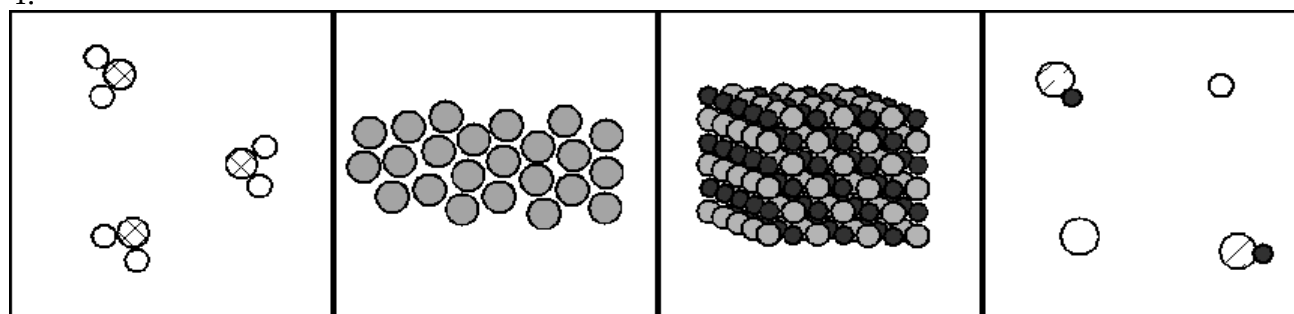
A

B

C

D

4.



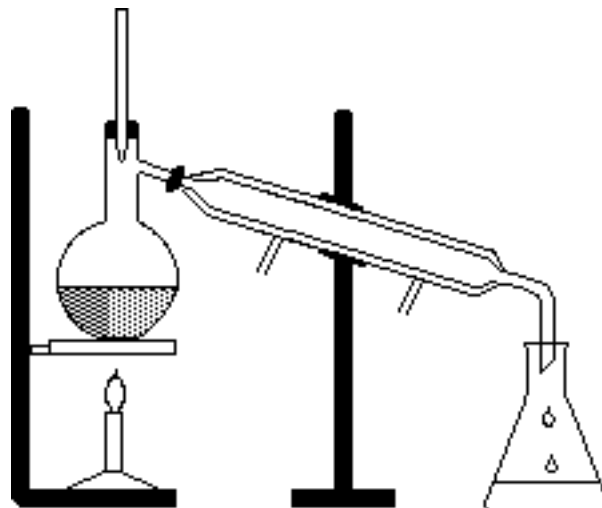
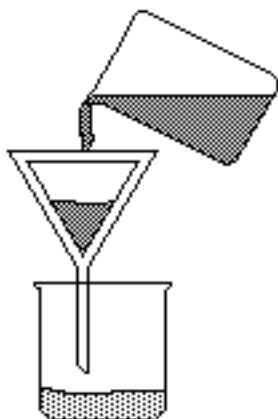
A

B

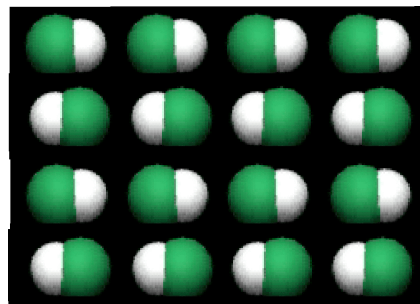
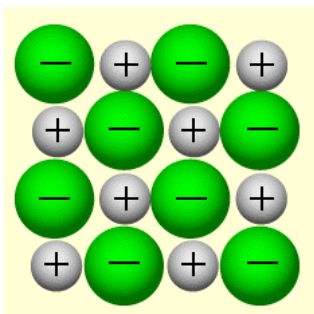
C

D

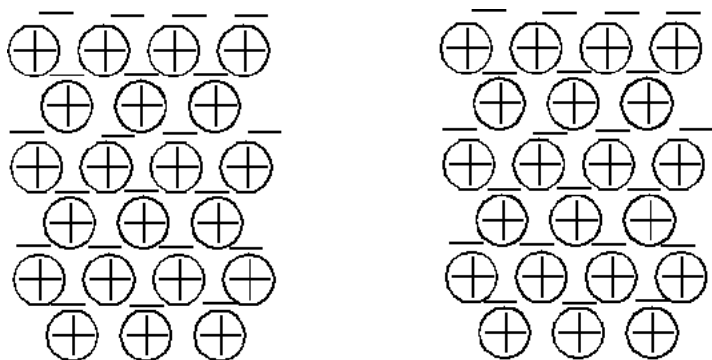
6. Identify the separation techniques pictured below. Which technique would be useful to separate a mixture of sand and salt? Of salt and water?



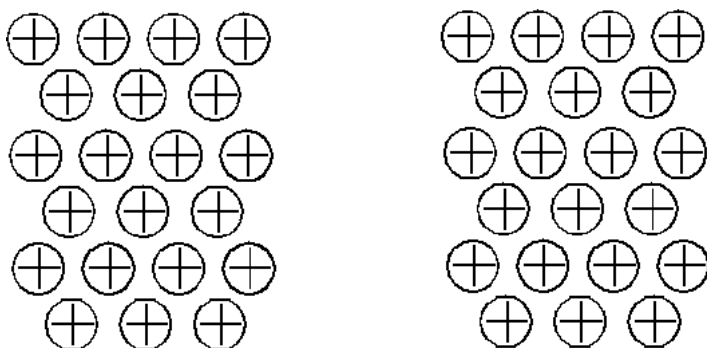
7. Below left is a 2-D array that represents an ionic lattice. At right is a 2-D array that represents a molecular solid. In what ways are they similar? In what ways are they different?



8. Recall your representations of the atoms in the Sticky Tape activity. Below is a pair of tapes before they have been pulled apart. Explain why they would **not** exert either an attractive nor a repulsive force on one another.



9. Below are groups of the inner cores of the atoms of the tapes. Sketch in the mobile negative charges to show how the top tape becomes (+) and the bottom becomes (-). Be sure to label each tape.



10. Below is a group of the inner cores of a piece of metal foil. Sketch in where you would expect to find the mobile negative charges if a top (+) tape were brought to the left of the foil. Explain your diagram.

